Historic, Archive Document

Do not assume content reflects current scientific knowledge, policies, or practices.

FIRE MANAGEMENT NOTES

SUMMER 1977 Volume 38, Number 3

U.S. DEPARTMENT OF AGRICULTURE • FOREST SERVICE

FIRE MANAGEMENT NOTES

An international quarterly periodical devoted to forest fire management

TABLE OF CONTENTS

The San Dimas Forestland Residues Machine

This forestlands residues machine was designed at the Forest Service Equipment Development Center at San Dimas, Calif. This second generation developmental model, completed in May 1977, is being tested in the Pacific Northwest. See the lead story in this issue for more information.

FIRE MANAGEMENT NOTES is issued by the Forest Service of the United States Department of Agriculture, Washington, D.C. The Secretary of Agriculture has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through September 30, 1978.

Subscriptions may be obtained from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. The subscription rate is $3.00 per year domestic or $3.75 per year foreign. Postage stamps cannot be accepted in payment.

NOTE—The use of trade, firm, or corporation names in this publication is for the information and convenience of the reader. Such does not constitute an offical endorsement or approval of any product or service by the U.S. Department of Agriculture to the exclusion of others which may be suitable.

Bob Bergland, *Secretary of Agriculture*

John R. McGuire, *Chief, Forest Service*

Henry W. DeBruin, *Director, Aviation and Fire Management*

J.O. Baker, Jr., *Managing Editor*

The San Dimas Forestland Residues Machine

Michael 'B' Lambert and William L. McCleese

Figure 1.—Precommercial thinning of the Tahoe National Forest.

For many years, land managers have been wrestling with the problems created by slash from precommercial timber thinning. Slash, often exceeding 20 tons per acre, creates an unacceptable fire hazard, impedes movement of wildlife and domestic livestock, and is considered an eyesore by the public. Treating slash is expensive and often difficult as a second operation following thinning.

Limits of Existing Machines

On lands where machines can operate, an obvious solution to the slash problem is to thin and treat the slash in one operation. Several commercial machines can handle trees up to 2 inches diameter at breast height (d.b.h.)—measured 4½ feet above the ground—but larger trees, stumps, and rocks quickly put them out of business.

In 1972 the Forest Service Equipment Development Center at San Dimas, Calif., (SDEDC) was commissioned to identify equipment that could thin and treat slash in one operation. If none could be recommended, the Center was to design a machine that would overcome the deficiencies of existing machines. Operational requirements included:

- Capability of thinning and treating trees up to 6 inches d.b.h.
- Ability to operate on slopes up to 15 percent
- Ability to work among rocks, stumps, and occasional large logs without damaging the machine.

After many trials and tests, the conclusion was reached that existing machines could not meet the criteria (Forest Service 1975). Several problems were encountered. Some machines provided insufficient treatment with long poles and whips left leaning in the leave trees. In some cases there was too much treatment with extremely fine mulch piled in a thick mat across the forest floor. Inability to cut trees up to 6

Continued on next page

Mr. Lambert is an Equipment Development Engineer with the Forest Service Engineering Staff in Washington, D.C. Mr. McCleese is Forest Supervisor of the Ochoco National Forest in Prineville, Oreg.

inches d.b.h., high costs per acre, excessive machine breakdowns, and high safety risks due to broken blades and flying debris were other problems encountered.

New Concepts Identified

The San Dimas engineers found that existing machines had been built largely by trial and error. They also discovered that there was no sound data base for wood cutting dynamics, applicable to these kinds of machines, from which a logical design could be initiated. So, a special dynamometer was built with provisions to cut full-sized roundwood by rotating different cutters under controlled conditions. Using this device, the engineers studied the relationships of cutter revolutions per minute (r/min), feed rate, horsepower, feed force, and wood size (Lambert 1974). Electronic information (from torque sensors, load cells, strain gages, etc.) was supplemented by visual observations of the cutting action through high-speed photography.

With knowledge gained from this slash cutting dynamometer and with experience from past field tests (Forest Service 1975), San Dimas engineers developed some new concepts for an improved cutter head. Four of these concepts are described here.

High Kinetic Energy: Each wood-cutting flail (blade) should have enough stored energy, in the form of inertia and angular velocity, to fracture the wood without large deflections.

Dull Blades: Dull blades (flails) reduce fuel to an acceptable size by effective energy transfer. They are less sensitive to rock and dirt than sharp blades and give longer useful field life.

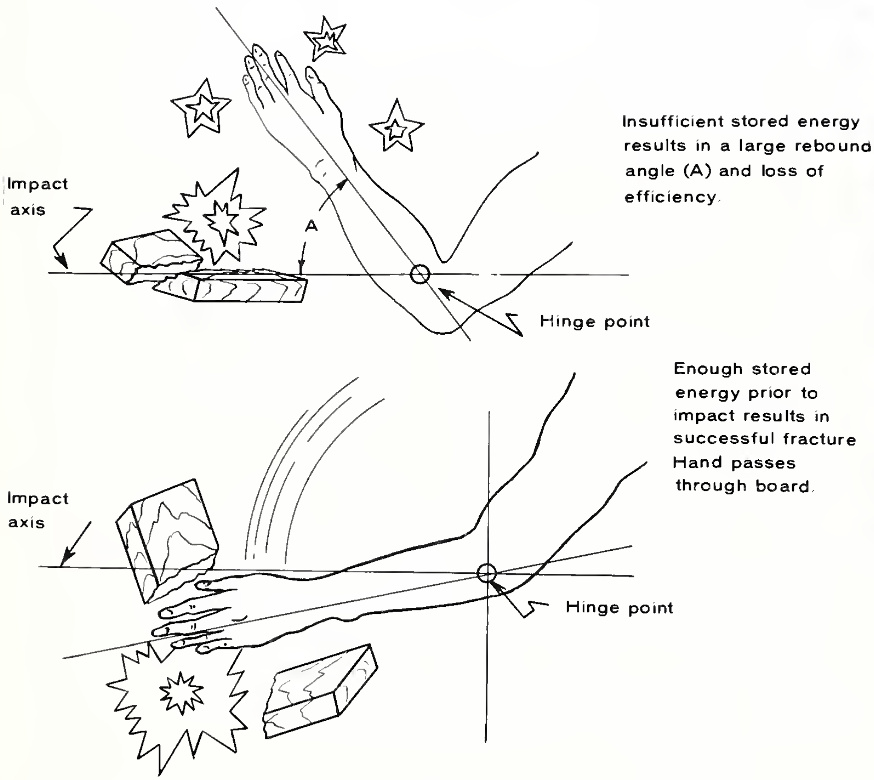
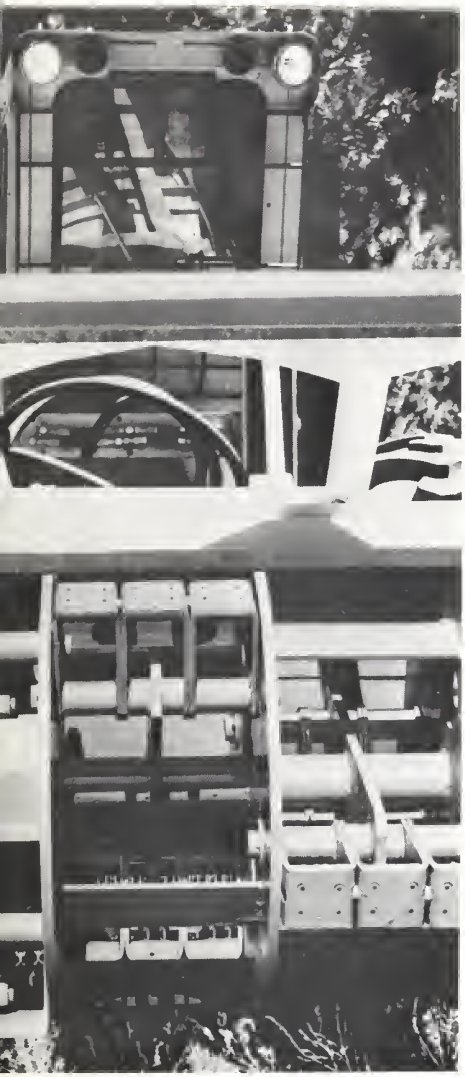


Figure 2.—Each wood-cutting flail should have enough inertia and angular velocity to fracture the wood without large deflections.

Figure 3.—Developmental model reduction head.



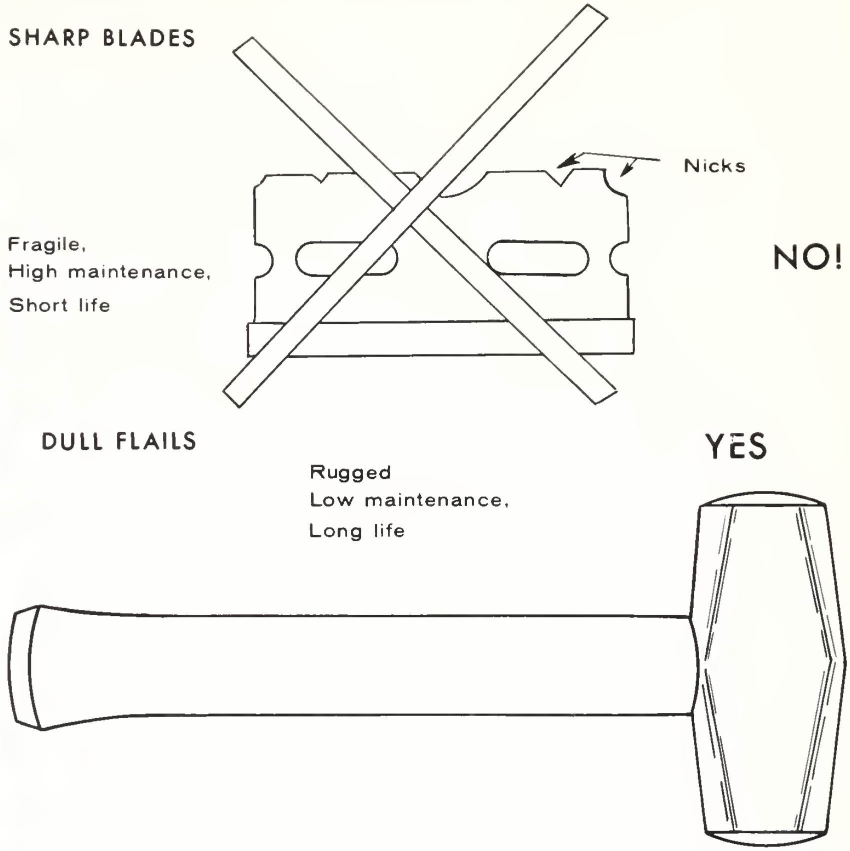


Figure 4.—Dull blades reduce fuel by effective energy transfer and are less sensitive to rock and dirt than sharp ones.

Flail Timing and Positioning: Each flail should be in position to strike the wood on every revolution. Proper timing improves cutting efficiency and reduces the impact forces transmitted through the machine.

Center of Percussion: When the flail is designed with its center of percussion close to its impact edge, dynamic shock loading to the machine is greatly reduced and cutting efficiency is correspondingly improved.

Design Concepts Field Tested

All of these and other new concepts have been incorporated into hardware for field testing. Figures 1 and 2 show the initial developmental model, which was operated at SDEDC and on the San Bernardino, Tahoe, Plumas, and Deschutes National Forests in 1976. Those field tests have shown the design concepts to be valid (Cammack and Lambert 1976). In addition to meeting the original operational requirements, the machine shows real promise for treating existing thinning slash and light logging slash.

During fiscal year 1977, the wider cutter head shown in the cover photo is being tested, and the search for a more suitable prime mover is continuing.

Industry is showing interest in the new design, and one manufacturer is already building a second machine. Hopefully, operational models will be available for purchase later this year.

Continued on next page

SAN DIMAS MACHINE
from page 5

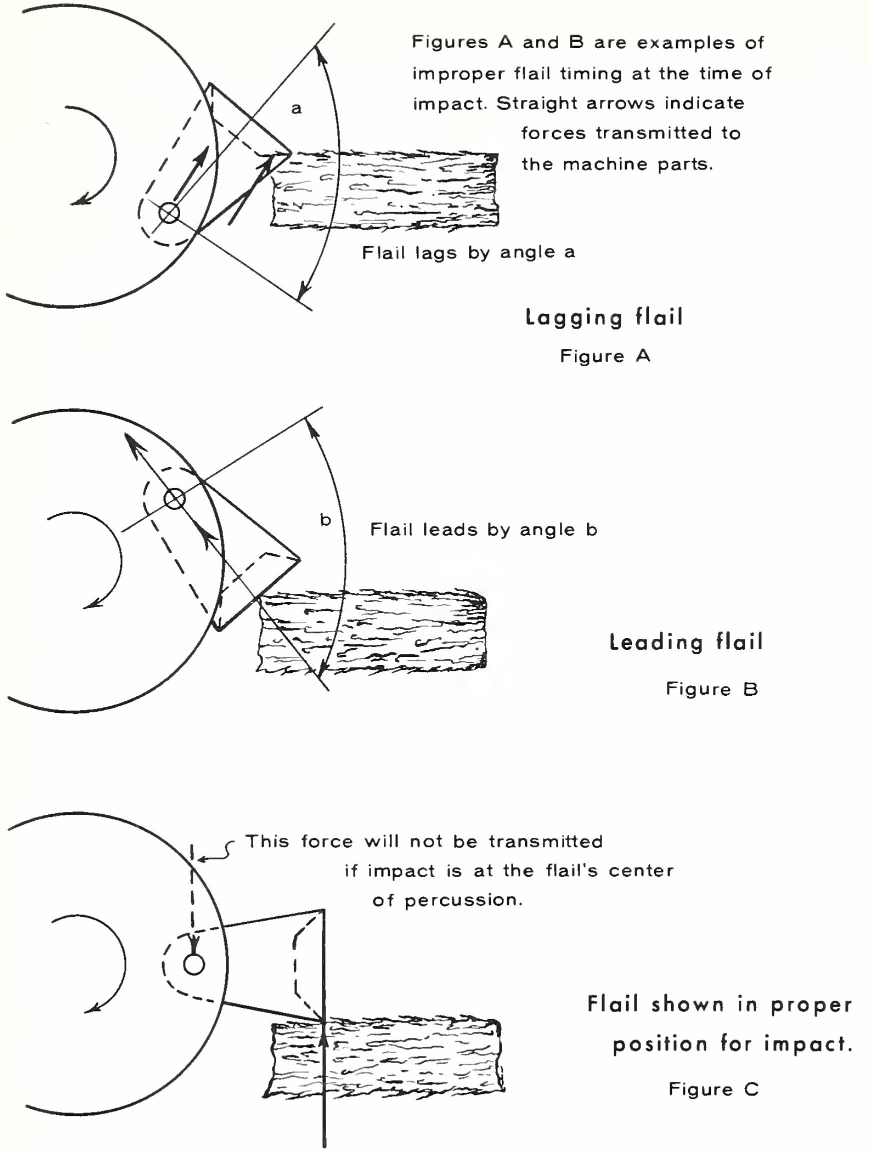


Figure 5.—For proper cutting efficiency, each flail should be in position to strike the wood on every revolution.

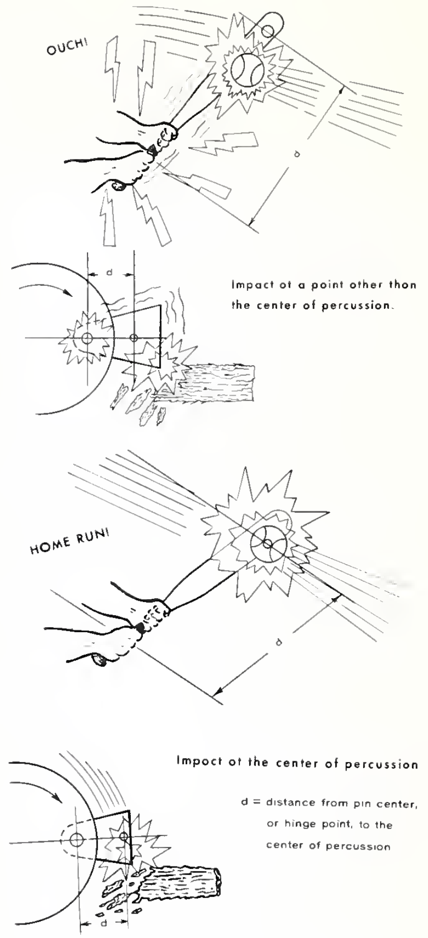


Figure 6.—Dynamic shock leading to the machine is greatly reduced when the flail's center of percussion is close to its impact edge.

Literature Cited

Cammack, Fred, and Michael 'B' Lambert.
1976. Parameters for the design of efficient forest residues reduction machinery. Am. Soc. Agric. Eng. Pap., ASAE 76–1573., St. Joseph, Mich.

Forest Service.
1975. Slash-equipment and methods for treatment and utilization, ED&T Rep. 7120–7. USDA For. Serv. Equip. Dev. Cent., San Dimas, Calif.

Lambert, Michael 'B'.
1974. Evaluation of power requirements and blade design for slash cutting machinery. Am. Soc. Agric. Eng. Pap., ASAE 74–1570, St. Joseph, Mich.

The Effect of Precommercial Thinning on Fire Potential in a Lodgepole Pine Stand

Martin E. Alexander and
Richard F. Yancik

Fire managers are aware that precommercial thinning increases the fire hazard of a given area, and that resistance-to-control, rate-of-spread (ROS), fire intensity, and ignition potential may also be affected (Appleby 1970, Dell 1975, Dell & Franks 1971, Fahnestock 1968). Thinning slash is additional debris superimposed upon the naturally-fallen fuel that already exists in a stand. In any appraisal of fire hazard and proposed fuel treatment measures, natural residues must be taken into account (Olson & Fahnestock 1955). The question is, "How much and to what degree does precommercial thinning influence potential fire behavior in a thinned versus unthinned stand?"

An Illustration

In August of 1975, a precommercial thinning operation was conducted on 54 acres of pure, even-aged lodgepole pine on the North Park Ranger District of the Routt National Forest in north-central Colorado. This thinning operation provided an opportunity to compare quantitatively fuel characteristics and potential fire behavior before and after thinning. The operation was contracted by the Forest Service to a private firm at approximately $45 per acre and called for 12- x 12-foot spacing (302 trees/acre) with directional felling to prevent "jackstrawing." Lopping of slash was required only on material larger than 3.0 inches in diameter. No further fuel treatment measures were planned because their costs could not be justified.

Prior to the thinning, residual fuels and timber stand description measurements were completed as part of a broader investigation in fuels description of lodgepole pine stands by the senior author. Post-thinning fuel sampling was conducted by the staff of the Fuel Management Research Project of the Rocky Mountain Forest and Range Experiment Station, stationed at Fort Collins, Colo.

Site and Stand Characteristics

The area was located on an upper-slope site at approximately 9,200 feet in elevation with a westerly aspect and an average terrain slope of 13 percent.

Based on the examination of basal fire scars on isolated stand residuals

Continued on next page

Figure 1.—General view of the stand prior to thinning.

Mr. Alexander is a fire research officer with the Canadian Forestry Service at the Great Lakes Forest Research Centre, Sault Ste. Marie, Ont. Mr. Yancik is a graduate research assistant in the Department of Forest and Wood Sciences, Colorado State University, Fort Collins, Colo.

EFFECTS OF PRECOMMERCIAL THINNING

from page 7

and on increment cores from dominant overstory trees, it was found that the stand originated from a wildfire in 1872. Mean stand structure characteristics were determined from standard 1/300-acre fixed plots. Density of live stems was 5,250 per acre, and for dead stems it was 900 per acre. The average live stem height was 25 feet, and distance from ground to live crown base was 17 feet (fig. 1). The mean diameter at breast height (4.5 feet above the ground) for live stems was 2.8 inches, and for dead stems it was 2.1 inches.

Figure 2.—Fuel conditions as a result of precommercial thinning.

Fuel Characteristics

Understory vegetation consisted primarily of scattered "half-shrubs" such as kinnikinnick and whortleberry. The forest floor was totally covered by needle litter which enhanced horizontal fuel continuity.

An inventory of downed woody debris and organic matter was conducted within a 1-acre portion of the area using the planar intersect sampling method (Brown 1974) and needle litter collections. The results are summarized in table 1. Note the large amounts of rotten material greater than 3.0 inches in diameter on the site. This was the result of the antecedent fire-killed stand.

In virtually all categories, fuel weights doubled following thinning. Radical changes occurred in the 1.0- to 2.99-inch size class and in the seed cone components. More significant was the large amount of suspended fuel particles generated by the thinning, which resulted in an optimumly aerated and continuous fuel bed (fig. 2).

Fuel Description Item	Before Thinning	Contributed by Thinning	After Thinning
Loading, tons/acre			
<0.24" size class	0.4	0.7	1.1
0.25–0.99" size class	1.5	1.9	3.4
1.0–2.99" size class	2.4	15.9	18.3
3.0" + rotten size class	23.8	—	23.8
3.0" + sound size class	0.2	5.3	5.5
Forest floor litter	1.2	—	1.2
Needle foliage	—	2.9	2.9
Seed cones	1.0	7.3	8.3
Herbaceous vegetation (live & dead)	0.02	—	0.02
Ave. diameter of 3.0" + material, inches			
Rotten	6.2	—	6.2
Sound	4.0	3.3	3.3
Dead fuelbed depth, feet	0.3	1.5	1.5
Forest floor duff depth, inches	2.5	—	2.6

Table 1.—Mean ground and surface fuel description characteristics before and after the precommercial thinning operation.

Analysis of Fire Potential

The recent development of mathematical fire-behavior models allows us to complete the fuel appraisal process based on the fuels description data shown in table 1. The models (Albini 1976) can be used as management tools to visualize "real world" fire situations. In the case at hand, relative differences in fire behavior characteristics, rather than actual values are the important points. Using the fire spread and intensity model (Rothermel 1972) developed at the Northern Forest Fire Laboratory in Missoula, Mont., quantitative estimates of fire ROS and intensity were calculated for three different situations:

- before thinning
- after thinning
- as if the fuel bed depth were reduced to 6 inches by mechanical crushing or some other compacting measure.

Two assumptions made were that (1) the area was regarded as 1-year old in a "red slash" condition, and (2) the mechanical crushing would not alter the physical structure and composition of the thinning slash other than the fuel bed depth.

Fire Potential Predictions

The predictions showed that ROS after thinning would be approximately 3.5 times greater than in the unthinned stand (fig. 3). Reaction intensity (the rate of heat output per unit area) could be expected to be 3 times greater than that before thinning (fig. 4). If mechanical crushing is used as a fuel treatment method in the area, reductions in fire ROS and intensity can be achieved. In fact, the fire behavior is predicted to be even less intense than before the thinning operation! This is due to a more compacted fuel bed.

At a 5-percent dead fuel moisture content (1-hr. time lag) and with a 10 mi/h windspeed, flame lengths in the thinning slash would exceed 7 feet. Under the same conditions and considering a half hour delay from detection to arrival on the fire scene by initial attack forces, the area burned would be approximately 5 acres and have a perimeter of 32 chains.

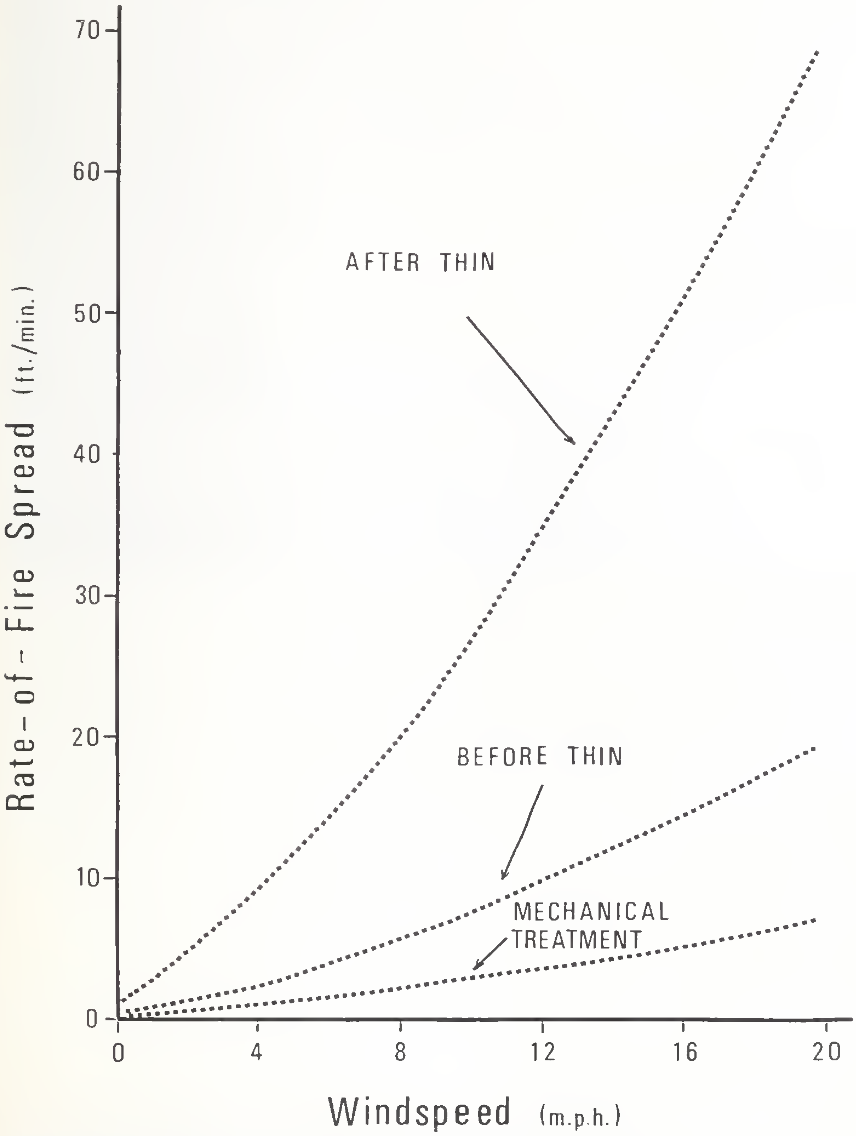


Figure 3.—Predicted rate of spread at 5-percent dead fuel moisture content (1-hour time lag) for the fuels before and after the precommercial thinning and the influence of mechanical crushing.

Conclusions and Implications

This small-scale investigation has shown quantitatively, from both a fuel attrition and potential fire behavior standpoint, the effects of precommercial thinning in a "doghair" lodgepole pine stand. "Simulation" of mechanical crushing revealed a viable alternative in fuel modification necessary to reduce the fire hazard to an "acceptable" level. Direct initial attack by hand crews on a fire in the thinned slash would not be possible under many burning conditions. Fire duration or persistence as a result of the deep duff layer and large quantities of rotten debris could cause extensive mopup work.

Loss of direct and indirect silvicultural investment (contract and salary monies), the value of the residual stand itself, surrounding area values, associated suppression costs if a fire were to occur, and the expense of cost-effective fuel treatment must be weighed before and after thinning. Extra fire protection measures (i.e., fuelbreaks) may not be a viable alternative, as aesthetics and wildlife habitat values must be taken into account as well.

Before the economies of the situation can be adequately evaluated, fire risk, frequency of critical fire weather conditions, and the longevity of the slash hazard (i.e., foilage retention) must be considered. The point to be remembered is that land managers need a reliable system for evaluating the effectiveness of various fuel treatment measures. If prethinning fuel inventory and stand description data are obtained, the existing fire behavior models can be used to help make more intelligent decisions concerning fuel treatment alternatives.

Literature Cited

Albini, F. A.
1976. Computer-based models of wildland fire behavior: a users'

Continued on page 20

One District's Answer to a Safe, Efficient, Attractive Heliport

Charles Petersen

During 1975, Forest Service Chief John R. McGuire organized a National Helicopter Operations Study to examine various policies and procedures to increase the safety and efficiency of all helicopter operations in the Forest Service. In the final report of this study, the Chief listed several items to be implemented by the 1976 fire season—one of which was the advent of a program to raise the standards of all base heliports. This program was to begin with the implementation of dust abatement on base heliports to reduce the serious problem of foreign object ingestion by helicopters, especially in turbine helicopters.

The fire management organization on the Canyon Ranger District of the Clearwater National Forest in northern Idaho began the program by surfacing the landing pad on the District's base heliport. They continued with several other improvements that resulted in a relatively inexpensive, safe, efficient, and attractive base heliport.

Heliport Described

The District's heliport originated, like most others, as a mound of dirt and gravel 3 feet high, 30 feet wide, and 50 feet long. It had a cribbed loading dock at one end. The mound and surrounding area were sparsely covered with grass and whatever else that would grow in the marginal soil conditions. Dust control was attempted with a lawn sprinkler. This generally held the dust down, but blowing material and debris were still a problem during normal helicopter operations. Helicopter fuel was stored at the heliport in 55-gallon drums.

Concrete Landing Pad

Work began in 1975 during late summer. The loading-dock cribbing was replaced with salvaged 6- x 13-inch treated bridge timbers faced with three-quarter-inch stained exterior plywood. Then a 30- x 28-foot landing pad was surfaced with 4 inches of concrete. The 10 yards of

---

Mr. Peterson is a Fire Management Technician on the Canyon Ranger District, Clearwater National Forest, Orofino, Idaho.

concrete cost approximately $500. This was commercially prepared concrete, with a 60-mile delivery trip that made the cost somewhat higher than could be expected on the average.

During this time the District station's groundline phone system was extended to the heliport. This provided communications between the heliport, dispatch office, fire cache, warehouse, and the dispatcher's residence.

Underground Fuel System

Near the end of the 1975 fire season, an underground electrically-operated fuel system was installed. This included a 500-gallon tank buried 2 feet underground and located approximately 100 feet from the heliport. The tank was vented to a height of approximately 15 feet to prevent water contamination during heavy snow buildups in the winter. The vent pipe was attached to the wind indicator pole for further protection. A Tokheim metered pump was mounted above ground over the tank.

The fuel is filtered at the pump. It travels underground to the heliport and is filtered a second time through a "Go-No-Go" filter just prior to being pumped into the helicopter. The filter, 52 feet of hose, nozzle, and grounding cable are stored in an open-end 55-gallon drum cemented in the pad. The drum is equipped with a steel, hinged lid for safety and protection when the fueling system is not in use.

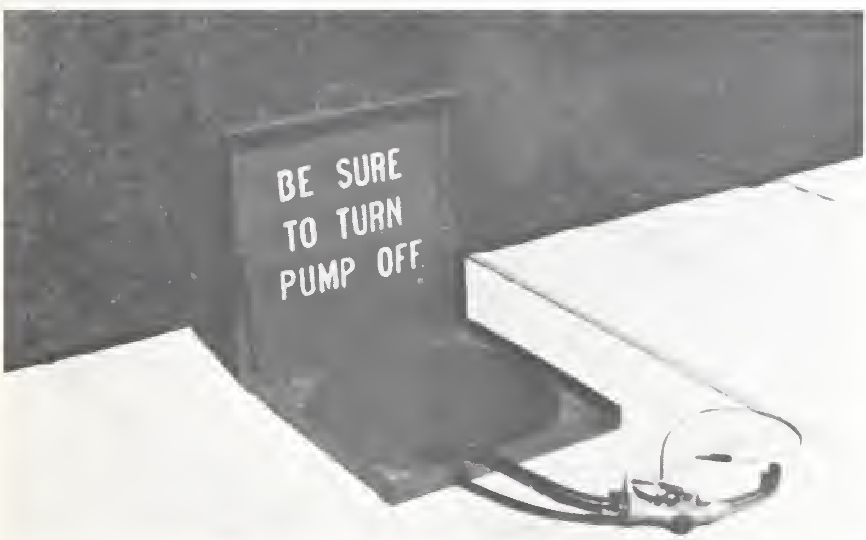
The cost of materials for the underground fuel system was approximately $500.

Air vent and wind indicator arrangement.

Grass Eased Problem

During the spring of 1976, topsoil was hauled in and several inches were spread over the entire heliport surrounding the concrete pad. Seed and fertilizer, along with an underground sprinkler system, provided a lush cover of grass and clover for approximately 50 feet around the landing pad. The grass eliminated the problem of blowing material and debris during operations. Before refueling the ship, most pilots prefer to discharge a small amount of fuel from the fuel pump nozzle to rid it of any contaminants that may have collected during storage. This fuel is normally discharged at the edge of the pad where it not only kills the vegetation but creates a fire hazard. To solve this problem a small screen-covered funnel was placed flush with the ground at the edge of the pad. A short length of hose connects the funnel to a punctured metal container buried several feet underground. Pilots can discharge the unwanted fuel into the funnel, it flows to the underground container and seeps away.

The entire heliport rejuvenation project was carried out by the District's fire management personnel. It created projects which kept initial attack firemen usefully employed at the District Headquarters, where they were also immediately available for fire assignment if needed. The result was an efficient, safe base heliport.



Underground container houses hose, nozzle, grounding cable, and Go-No-Go filter while not in use.

"T" Cards Provide Versatile Resource Status System

Richard A. Chase

Automated data processing technology probably will ultimately provide the ideal solution to the problem of maintaining information on the current status and location of fire suppression resources. But present practical considerations of costs and availability of suitable operational systems still dictate that manual systems be used for most field applications.

A variety of these have been developed for local use and little standardization exists. However, card-type systems generally have been found to be most adaptable to the varied requirements and are prevalent.

A major drawback to most card systems for many applications is the size, bulkiness, and/or display characteristics of the card rack or holder. These limitations are particularly significant where portability is a factor, and information must be kept on large numbers of resource units.

"T" Cards and Racks

One system that overcomes these difficulties uses "T"-shaped cards and either vertical metal racks (fig. 1) for wall displays, or plastic folders (fig. 2) where small size and transportability are important. All items are available from most office equipment supply sources.

Richard Chase is a Forester at the Pacific Southwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture, Berkeley, Calif. He is stationed at Riverside, Calif.

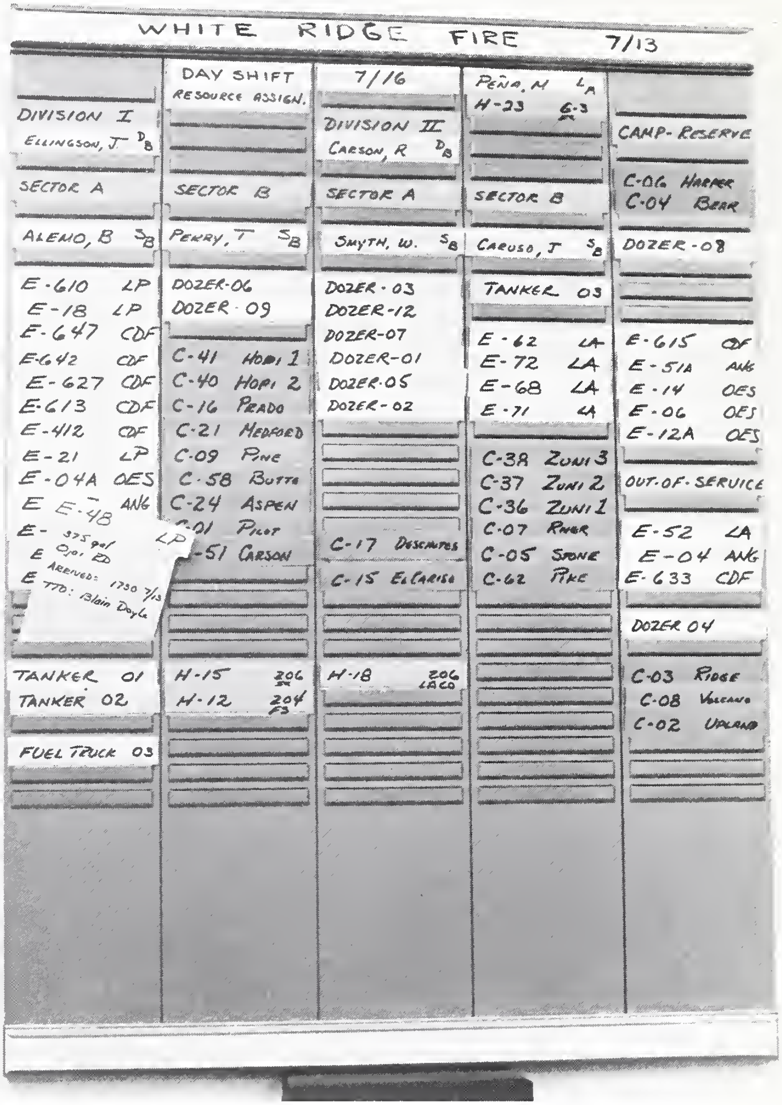


Figure 1.—This compact, light metal card rack can be either permanently wall-mounted or carried to a fire or other location and set up for temporary use.

The light-weight, stamped metal strips are available in lengths with 30, 40, or 50 slots, and in widths to accommodate 2-, 3-, or 4-inch-wide cards. The strips can be assembled into panels up to 30 inches wide, and panels may be mounted next to each other to form continuous assemblies for larger displays. The 5-strip panel shown in figure 1 is 19 inches wide

Figure 2.—The plastic holder folds to a 9½- by 12-inch size for carrying in the field.

by 26 inches high, weighs less than 5 pounds, and holds 150 3-inch-wide cards.

The portable plastic holder accommodates 30 shorter cards per panel. Two to eight of the hinged panels can be joined together to form a compact folder that can be easily carried for field use.

In both types of holder, the "T" shape of the card holds it in the slot with the top, on which unit identifier or other heading is written, clearly visible. Information concerning the unit (size, type, home base, etc.) is written on the body of the card (which can be preprinted to receive standard items) and can be quickly accessed as needed (fig. 3).

By keying each resource type to a different color card, the informational value of the overall display is greatly increased, and a quick general picture of the amount and kind of resources assigned to any location can be determined at a glance. Such color coding also helps reduce the search time required to locate any specific resource unit's card.

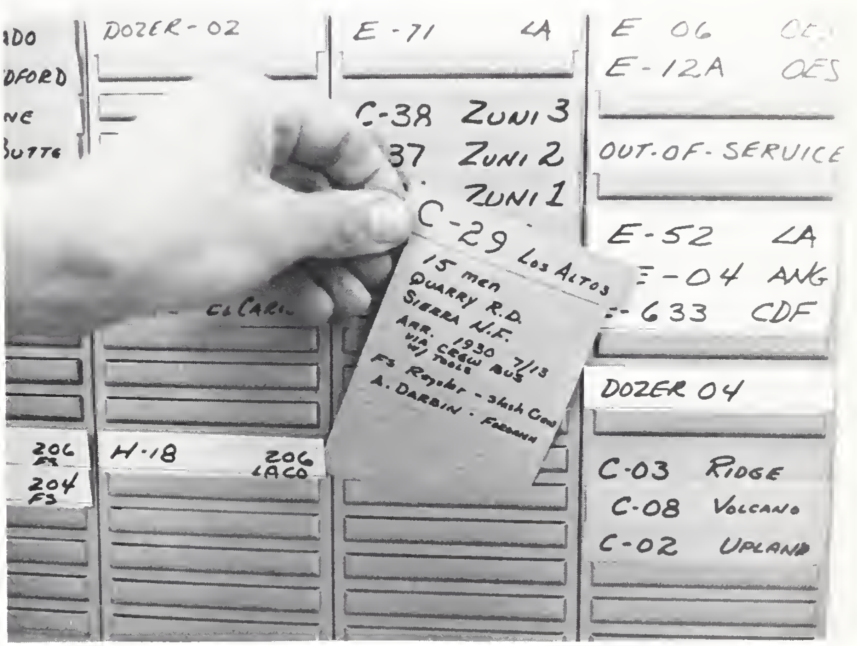


Figure 3.—The cards are held in the rack so that heading are readily visible. Any information about the particular unit is entered on the body of the card.

Standard Color Code

To promote standardization among fire organizations, the following card colors, which conform to those being used in a number of existing systems, are recommended:

- Gray—header or title cards for location, assignment, etc.
- White—overhead
- Green—crews
- Yellow—bulldozers, tractor plows
- Red—engines (e.g., pumpers)
- Blue—helicopters
- Orange—fixed–wing aircraft
- Tan—other resources.

Resource-status-keeping systems utilizing "T" cards have been established in a number of dispatch offices, and have also been successfully tested on several large fires. In addition, the system has been adapted for nonfire administrative scheduling and information display applications.

Preventing Fireworks Fires on the San Bernardino National Forest During the Bicentennial July 4th Holiday

James L. Murphy and
Eugene E. Murphy

"The worst fire season in history!" This was the prediction southern California fire managers were making as the July 4th weekend approached. It was 1976—the Bicentennial year. People celebrate July 4th by setting off fireworks. But this year people would be celebrating both the July 4th and the Bicentennial. More fireworks; more fires in the forest. And this is precisely what fire managers on the San Bernardino National Forest feared. Not only more fires, but this year conflagrations. A new, innovative prevention program was a must. And there was less than a week to design and implement the program. But it was done, and fires were prevented. How it was done is the story this article relates.

Fireworks stand proprietor explains forest fire danger. (Photo courtesy of San Bernardino *Sun-Telegram*.)

Extreme Fire Danger—Record Fireworks Sales

The fire season in southern California began early in 1976. By early June severe drought conditions prevailed throughout the State. Rainfall was 3 percent of normal in some areas. The Palmer Drought Index measured hazard conditions typical of October on the southern California National Forests. And on the San Bernardino National Forest the overall "buildup" and ignition potential were equivalent to late September.

Experienced firemen estimated that ignition and large fire potential were 10 to 20 times higher than normal. By mid-June, the Forest had already experienced 49 man-caused fires. The 5-year average for the same period was 29 fires. San Bernardino National Forest fire managers remembered all too clearly past fireworks-caused fires on the Forest. On July 3, 1973, the One Horse fire was started by fireworks and devastated 10,000 acres.

San Bernardino, a city of 100,000 people, is located on the south side of the National Forest. The urban encroachment on the wildlands of the San Bernardino and San Jacinto Mountains is extensive, and incidences of fire starts and damage potential are some of the highest in the Nation. The sale of fireworks is permitted in San Bernardino.

A quick check with fireworks manufacturing companies supported the land manager's fears that because of the Bicentennial celebration sales

---

James L. Murphy is Leader of the National Wildfire Prevention Project, Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif. Eugene Murphy is Deputy Forest Supervisor on the Eldorado National Forest in Placerville, Calif.

of fireworks were up. A spokesman for fireworks manufacturers said sales were, "Fantastic." "Demands have increased as much as 120 percent." In fact, "The California fireworks industry hired 1,200 extra workers."

The extreme fire danger, the impending Bicentennial July 4th holiday, and the alarming increase in fireworks sales, all combined to make one or more conflagrations almost a certainty. A completely new prevention program had to be designed and implemented—and quickly. The San Bernardino National Forest fire managers and scientists of the Forest Service Fire Laboratory at Riverside, Calif., teamed up to do the job.

Focusing on the Fireworks Fire Problem

Early in 1976 scientists in the newly chartered National Wildfire Prevention Project at the Riverside Fire Laboratory had begun research which would lead to the development of the FOCUS Prevention Module (Phoenix 1976). The San Bernardino National Forest with its high resource values, history of large fires, and high incidence of man-caused fires was a natural to serve as a study area for the research and development effort. The forest fire management staff, together with the prevention project scientists, concluded that an updated and more detailed analysis of the fireworks fire problem on the San Bernardino National Forest was first priority in designing a new prevention program.

Fifteen years of fire statistics for the Forest, extracted from individual fire reports (Forest Service Form 5100–29), had been on electronic data processing (EDP) tape and were stored in the Fire Laboratory's Computer Library. But a special computer program had to be developed to answer the very specific questions posed by the fire managers which were basic to the design of a prevention program to counter the fireworks fire threat.

A New Research Tool

Specific detailed data describing past fireworks-caused fires on the San Bernardino were not available. For quick and easy analysis, researchers wrote a special program to extract, compile, and stratify data from the individual fire reports which had been placed on EDP tape.

In general, the program produced cross tabulation tables which described two variables individually, e.g., fire-cause, year of occurrence, and their joint relationship. Four tables, or matrices, are produced by the program:

- A frequency table
- A table showing percentages of total frequency
- Percentage of row totals
- Percentage of column totals.

Tables in this format were developed for 34 individual variables describing past fireworks fires. Wildfire data, presented in this manner, made a quick and relatively easy analysis possible. Trends over the 5-year period could be identified and problems defined—the basis for design of a prevention action plan.

Problem Analysis by Fire Managers and Scientists

Computer printout of the data was available for analysis within 30 minutes. Fire managers and researchers met to derive practical conclusions which would lead to the design of prevention action plans. From the data they determined several facts.

Almost 60 percent of all fireworks fires occurred on the Cajon Ranger District on the north end of the Forest. Two of the five ranger districts had no history of fireworks fires.

About 53 percent of fireworks fires started on National Forest land, another 35 percent started on National Forest protected lands, and 11 percent started outside National Forest protected lands.

Almost 65 percent of fireworks fires were caused by forest visitors, 35 percent of which were children-caused.

All fireworks fires started between noon and 5:00 p.m. Fifty-nine percent of fireworks fires were discovered in less than 6 minutes, and 88 percent of them in less than 12 minutes. Sixty-five percent started on slopes over 10 percent and 35 percent on slopes from 70 to 79 percent.

Forty-seven percent of all fireworks fires were controlled at less than ¼ acre. But over 35 percent of all fireworks fires burned more than 5,000 acres. Forty-one percent of fireworks fires cost between $5,000 and $25,000 to suppress, and 81 percent of them were in the $2,000 to $3,000 per acre value class.

And, finally, on the basis of the analyses, researchers predicted that during a "normal" year the Forest could expect on the average 2.83 fires with a 50 percent chance of burning 6,851 acres, with suppression costs of $34,741.

However, 1976 was not a "normal" year. Fire managers and researchers together predicted the San Bernardino National Forest would experience six fireworks fires, and two of them would be major fires in excess of 5,000 acres.

Prevention Action for the Bicentennial July 4th Holiday

A July 4th holiday fire prevention plan for the Bicentennial year was quickly developed, based on the problem analyses. In 8 hours a prevention action plan was implemented.

Check stations were established on key roads leading into high risk areas, such as the Cajon District. The fire prevention message emphasized the extreme fire danger and that fireworks were prohibited within the National Forest. A new sign plan was developed. Signs were placed on roads leading into the Forest and into campgrounds informing visitors that fireworks were prohibited in the National Forest. The June 6, 1977, San

Continued on next page

PREVENTING FIREWORKS FIRES

from page 15

Bernardino *Sun-Telegram* reported that "motorists voluntarily surrendered enough fireworks in 8 hours to fill a 50-gallon trash can."

A detailed study was made of the 11 percent of fireworks fires occurring immediately outside National Forest land. The study revealed the necessity for intensified State and city fire prevention efforts. Forest officers worked with the State and city fire services in developing a cooperative prevention action plan based on accelerated patrol and public contact for the interface areas.

Forest officers were designated to make personal contact with all newspapers and radio stations. Mass media efforts were targeted at forest visitors, especially children, informing them of the danger of fireworks fires and of laws prohibiting fireworks on the National Forest.

Prevention activities were intensified between noon and 5:00 p.m. each day during the 3-day holiday weekend. Emergency lookouts were established, and initial attack crews were instructed to establish minimal getaway times during these hours when the potential for fire starts and damage was greatest. Because of the extreme fire danger, discovery time standards were reduced to 2 minutes or less to counter the disaster fire potential.

Results of the analysis, which included the potential numbers of fires, their location, potential damage, and conditions of occurrence, were fundamental in convincing top-level management and field technicians of the seriousness of the fire problem. Analytical results, such as potential fire damage, were especially valuable in providing fact and reality to mass media messages.

CELL FREQUENCY COUNTS   YEAR (VAR 4)

STAT C (VAR 6)		1970 70.0	1971 71.0	1972 72.0	1973 73.0	1974 74.0	1975 75.0	TOTAL
LIGHT	1.00	0	0	0	0	0	0	0
EQ. USE	2.00	0	0	0	0	0	0	0
SMOKING	3.00	0	0	0	0	0	0	0
CAMPFIRE	4.00	0	0	0	0	0	0	0
DEBRIS	5.00	0	0	0	0	0	0	0
RAILROAD	6.00	0	0	0	0	0	0	0
INCENO	7.00	0	0	0	1	0	1	2
CHILD	8.00	0	1	0	0	3	2	6
MISC	9.00	5	0	2	1	1	0	9
TOTAL		5	1	2	2	4	3	17

STATISTICS BASED ON THE FREQUENCY TABLE

STATISTIC	VALUE	D.F.	PROBABILITY	STATISTIC
CHISQUARE	17.708	10	0.0601	

PERCENTAGES OF THE TOTAL FREQUENCY

		1970 70.0	1971 71.0	1972 72.0	1973 73.0	1974 74.0	1975 75.0	TOTAL
LIGHT	1.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQ. USE	2.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SMOKING	3.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CAMPFIRE	4.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DEBRIS	5.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAILROAD	6.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INCENO	7.00	0.0	0.0	0.0	5.88	0.0	5.88	11.76
CHILD	8.00	0.0	5.88	0.0	0.0	17.65	11.76	35.29
MISC	9.00	29.41	0.0	11.76	5.88	5.88	0.0	52.94
TOTAL		29.41	5.88	11.76	11.76	23.52	17.65	100.00

PERCENTAGES OF THE ROW TOTALS

		1970 70.0	1971 71.0	1972 72.0	1973 73.0	1974 74.0	1975 75.0	TOTAL
LIGHT	1.00	0.0	0.0	0.0	0.0	0.0	0.0	100.00
EQ. USE	2.00	0.0	0.0	0.0	0.0	0.0	0.0	100.00
SMOKING	3.00	0.0	0.0	0.0	0.0	0.0	0.0	100.00
CAMPFIRE	4.00	0.0	0.0	0.0	0.0	0.0	0.0	100.00
DEBRIS	5.00	0.0	0.0	0.0	0.0	0.0	0.0	100.00
RAILROAD	6.00	0.0	0.0	0.0	0.0	0.0	0.0	100.00
INCENO	7.00	0.0	0.0	0.0	50.00	0.0	50.00	100.00
CHILD	8.00	0.0	16.67	0.0	0.0	50.00	33.33	100.00
MISC	9.00	55.56	0.0	22.22	11.11	11.11	0.0	100.00
TOTAL		29.41	5.88	11.76	11.76	23.53	17.65	100.00

PERCENTAGES OF THE COLUMN TOTALS

		1970 70.0	1971 71.0	1972 72.0	1973 73.0	1974 74.0	1975 75.0	TOTAL
LIGHT	1.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EQ. USE	2.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SMOKING	3.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CAMPFIRE	4.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DEBRIS	5.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAILROAD	6.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INCENO	7.00	0.0	0.0	0.0	50.00	0.0	33.33	11.76
CHILD	8.00	0.0	100.00	0.0	0.0	75.00	66.67	35.29
MISC	9.00	100.00	0.0	100.00	50.00	25.00	0.0	52.94
TOTAL		100.00	100.00	100.00	100.00	100.00	100.00	100.00

Examples of the computer printouts showing the layout of the four tables that are produced by the computer program.

Results

The factors that together predicted serious wildland fire losses for the Bicentennial July 4th weekend materialized. Fire danger was extreme. Forest visitors came in record numbers. Fireworks sales broke all records. However, the six predicted fireworks fires, two of them major fires, did not materialize. Only four fireworks fires occurred and these were controlled at less than ¼ acre.

Researchers and fire managers worked together to develop new analytical techniques for dealing with a predicted disaster during the Bicentennial July 4th holiday. A potential new management and research tool was developed that showed promise for quick and easy data display and interpretation basic to problem analyses and the design of effective prevention activity and programs.

With the help of this tool a new and innovative fire prevention action plan was quickly developed and implemented. The payoff was measured in fires that were prevented and in resources that were not damaged by fireworks-caused fires.

Literature Cited

Phoenix, W. B.
1976. FOCUS: how can it be used by fire managers? USDA For. Serv. Fire Manage. Notes 37(2):12–14.

New Smokey Bear Film

The new film, "Smokey Bear," is ready for distribution. It is a warm, human story of two happy children and their grandfather. The grandfather, played by Denver Pyle, well-known television and film star, tells the children how the familiar illustration of Smokey Bear has been the symbol for forest fire prevention since 1945.

They also learn the true story of the little live bear who, in 1950, was badly burned in a forest fire. A forest ranger found the cub and cared for him. The cub was later named "Smokey" and became the living symbol of forest fire prevention.

Getting along in years, the live Smokey handed over his hat and shovel to a young Smokey to carry on the message of preventing forest fires. Smokey Bear is alive and well and still needs our help.

"Smokey Bear" was produced by Jack B. Hively for the National Association of State Foresters, the Forest Service, and the Advertising Council, Inc. The film is aimed at young school children, kindergarten through sixth grade, and replaces the old motion picture, "Little Smokey."

It is being distributed by Film Communicators, 11136 Weddington Street, North Hollywood, CA 91601. This company is an official licensee of the Cooperative Forest Fire Prevention Program. The film, which comes with a teacher's guide, sells for $125 plus shipping and handling charges.

Denver Pyle, well-known television and film star, plays the lead in the new film, "Smokey Bear."

Recent Fire Publications

Adkins, C. W., and H. B. Clements.
1976. Photographic measurements of flame size over flat terrain. Funct. Photogr. 11(6):32–34.

Albini, Frank A.
1976. Computer-based models of wildland fire behavior: a user's manual. USDA For. Serv., Intermt. For. Range Exp. Stn., 68 p.

Baughman, Robert G., Donald M. Fuquay, and Paul W. Mielke, Jr.
1976. Statistical analyses of a randomized lightning modification experiment. J. Appl. Meteorol. 15(7): 790–794.

Bevins, C.
1976. Evaluation of the slash fuel model of the National Fire-danger Rating Systems. Master's thesis, Univ. Wash., Seattle, 104 p.

Burgan, Robert E.
1976. Correlation of plant moisture in Hawaii with the Keetch-Bryam drought index. USDA For. Serv. Res. Note PSW–307. Pac. Southwest For. Range Exp. Stn., Berkeley, Calif. 6 p.

Clayton, J. L.
1976. Nutrient gains to adjacent ecosystems during a forest fire: an evaluation. For. Sci. 22(2):162–167.

DeByle, Norbert V.
1976. Fire, logging, and debris disposal effects on soil and water in coniferous forests. XVI IUFRO World Congr. Proc., Vol. I, Oslo, Norway, p. 201–212.

Martin, R. E.
1976. Prescribed burning for site preparation in the inland northwest. IN Tree Planting in the Inland Northwest Conf. Proc., Feb. 17–19, 1976. Wash. State Univ., Pullman. p. 134–156.

McBride, J. R., and R. D. Laven.
1976. Scars as an indicator to fire frequency in the San Bernardino Mountains, Calif. J. For. 74(7):439–443.

All Purpose Pack Frame

The "All Purpose Pack Frame," designed and built by Forest Service employee Louis Deyak in Ely, Minn., is a very versatile piece of fire equipment. Currently, over 300 are in use by the Forest Service and the State of Minnesota. The pack frame is also being used in Alaska and in Australia.

The design of the pack frame permits it to be used for fire and other purposes as well. For example, up to 400 feet of 1½-inch linen hose can be carried in the frame. It can be used while making a "hose lay." By adding two cotter keys to the frame, a person can carry a portable pump. Of course, it can be used like any other pack frame for carrying equipment, clothing, food, etc.

The pack frame is constructed of readily obtainable materials. In fact many work centers already have most of the materials on hand. One frame can usually be fabricated for about $60. This includes labor and all new materials.

By following these five easy steps, you can build your own.

Step 1.—Cut all pieces of metal tubing to their proper lengths. Place in a jig and braze or weld the tubing into place. (See fig. 2.)

Step 2.—Add four pieces of 1½-inch linen hose to form a back rest. (See fig. 1.)

Step 3.—Construct the pack straps from 1¾-inch nylon webbing, ¾-inch web strapping, and two 1¾-inch "D" rings. Attach to the frame. (See fig. 1).

Step 4.—Add the four 18- x ½-inch nylon straps with buckles to the frame. Two go at the top and two at the bottom of the frame. (See fig. 2.)

Step 5.—Combine the four rubber bands and eight 1-inch "D" rings to form the hose-holding straps. Attach to frame. (See fig. 1.)

Fire hose can be prepared for packing on the pack frame by use of a special jig. The rubber hose-holding straps keep the hose snug in the frame while permitting the hose to be dispensed in a "fast lay" as the carrier walks at normal speed.

LIST OF MATERIALS

Description	***Quantity Needed***
Metal Tubing, ½-in. outside diameter, #20 wall seamless	25 ft.
Nylon webbing 1¾ in. wide	52 in.
"D"-rings 1¾ in.	2
"D"-rings 1 in.	8
Web strapping ¾ in. wide	48 in.
Harness rings ¾ in.	4
Nylon straps with buckles 18 x ½ in.	4
Rubber bands (made from 1300 x 24 inner tube) 1 in. wide	4
Linen hose 1½ x 32 in.	4

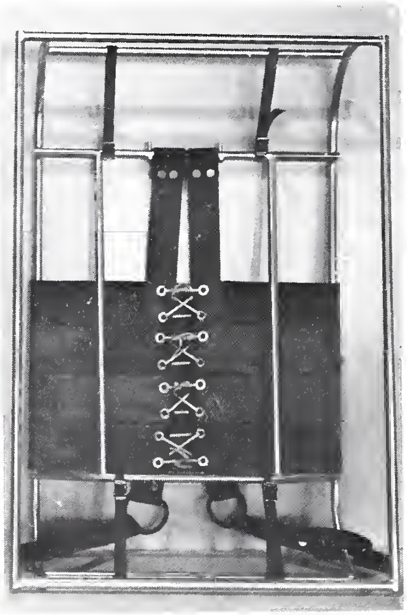


Figure 1.—The weight of the empty pack frame is 7 pounds. When loaded with 400 feet of 1½-inch hose, it weighs 72 pounds.

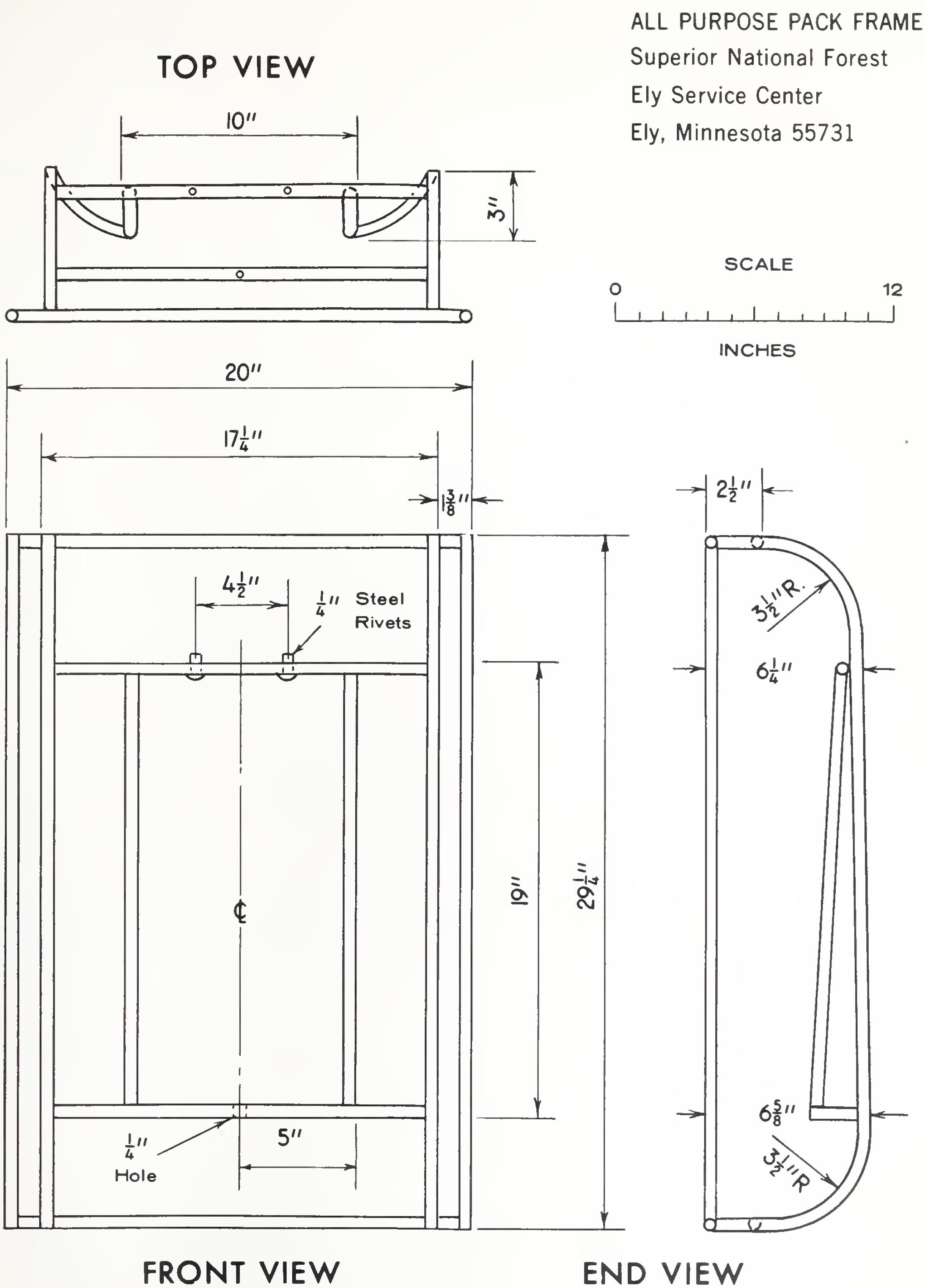


Figure 2.—Plans for the "All Purpose Pack Frame."

U.S. DEPARTMENT OF AGRICULTURE
WASHINGTON, D.C. 20250

OFFICIAL BUSINESS

POSTAGE & FEES PAID
U.S. DEPT. OF AGRICULTURE
AGR 101

U.S. MAIL

Third Class

EFFECTS OF PRECOMMERCIAL THINNING

from page 9

manual. USDA For. Serv., Intermt. For. Range Exp. Stn., Odgen, Utah. 68 p.

Appleby, R. W.
1970. Thinning slash and fire control. Fire Control Notes 31(1):8–10.

Brown, J. K.
1974. Handbook for inventorying downed woody material. USDA For. Serv. Gen. Tech. Rep. INT–16, Intermt. For. Range Exp. Stn., Ogden, Utah.

Dell, J. D.
1975. Fuels management . . . a key element in wildfire prevention. USDA For. Serv. Pac. Northwest Reg., Portland, Oreg., 16 p.

Fahnestock, G. R.
1968. Fire hazard from precommercial thinning of ponderosa pine. USDA For. Serv. Res. Pap. PNW–57, Pac. Northwest For. Range Exp. Stn., Portland, Oreg., 16 p.

Franks, D. E., and J. D. Dell.
1971. Thinning slash contributes to eastside Cascade wildfires. Fire Control Notes 32(1):4–6.

Olson, D. S., and G. R. Fahnestock.
1955. Logging slash: a study of the problem in Inland Empire forests. Univ. Idaho, Coll. Forest Wildl. Range Exp. Stn. Bull. 1, Moscow. 52 p.

Rothermel, R. C.
1972. A mathematical model for predicting fire spread in wildland fuels. USDA For. Serv. Res. Pap. INT–115, Intermt. For. Range Exp. Stn., Ogden, Utah. 10 p.

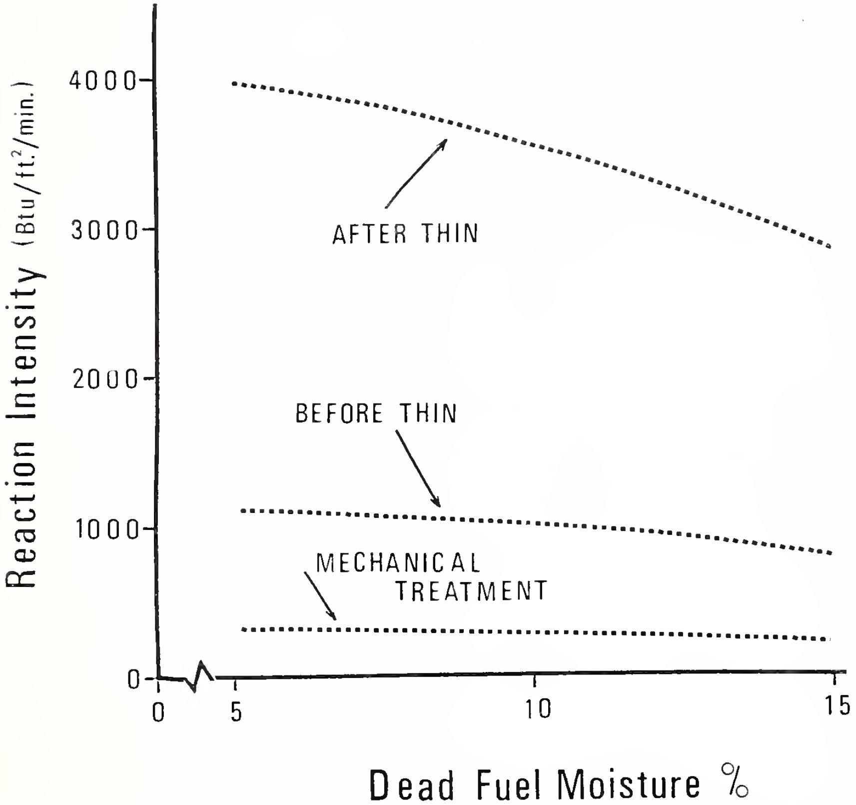


Figure 4—Predicted reaction intensity at 5 percent dead fuel moisture content (1-hour time lag) for the fuels before and after the precommercial thinning and the influence of mechanical crushing.

CAT77680365_006
Fire management notes / U.S. Department of Agriculture, Forest Service.
1 F766Fi
v.38:no.3

Batch: NAL18_0213

CAT77680365006